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GNRO-2011/00035

May 5, 2011

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Request for Additional Information Regarding
Extended Power Uprate
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCES:
1. Email from A. Wang to F. Burford dated April 5, 2011, GG EPU Electrical Engineering Branch Request for Additional Information (ME4679) (Accession Number ML110950281)
2. License Amendment Request, Extended Power Uprate, dated September 8, 2010 (GNRO-2010/00056, Accession Number ML102660403)

Dear Sir or Madam:

The Nuclear Regulatory Commission (NRC) requested additional information (Reference 1) regarding certain aspects of the Grand Gulf Nuclear Station, Unit 1 (GGNS) Extended Power Uprate (EPU) License Amendment Request (LAR) (Reference 2). Attachment 1 provides responses to the additional information requested by the Electrical Engineering Branch.

No change is needed to the no significant hazards consideration included in the initial LAR (Reference 2) as a result of the additional information provided. There are no new commitments included in this letter.

If you have any questions or require additional information, please contact Jerry Burford at 601-368-5755.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 5, 2011.

Sincerely,

MAK/FGB/dm

Attachments:
1. Response to Request for Additional Information, Electrical Engineering Branch

cc: Mr. Elmo E. Collins, Jr.
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Attachment 1

GNRO-2011/00035

Grand Gulf Nuclear Station Extended Power Uprate

Response to Request for Additional Information

Electrical Engineering Branch

Response to Request for Additional Information
Electrical Engineering Branch

By letter dated September 8, 2010, Entergy Operations, Inc. (Entergy) submitted a license amendment request (LAR) for an Extended Power Uprate (EPU) for Grand Gulf Nuclear Station, Unit 1 (GGNS). The U.S. Nuclear Regulatory Commission (NRC) staff has determined that the following additional information requested by the Electrical Engineering Branch is needed for the NRC staff to complete their review of the amendment. Entergy's response to each item is also provided below.

RAI # 1

In Figure 2.3-1 of Section 2.3 of the LAR, the licensee presented the worst case environmental qualification (EQ) enveloping accident temperature profiles. Explain whether Figure 2.3-1 represents profiles for both high energy line break (HELB) and loss of coolant accident (LOCA) conditions. Also, describe the impact of the change in rate between the existing drywell temperature and drywell temperature under EPU conditions on the EQ of equipment.

Response

Figure 2.3-1 delineates the worst case EPU environmental qualification enveloping profiles which include HELB and LOCA conditions.

The current licensed thermal power (CLTP) EQ accident temperature profile used for qualification of equipment bounds the EPU drywell enveloping accident temperature profile from Figure 2.3-1 until day 60, when the temperature is approximately 147°F. After 60 days, the EPU drywell enveloping accident temperature curve continues a downward slope (cooling) out to 100 days, but at a slower cool down rate than the CLTP EQ profile. This temperature difference from 60 to 100 days is acceptable for affected EQ equipment based on Arrhenius methodology, since margin exists in the predicted EPU drywell temperature accident response for EPU versus the drywell enveloping accident temperature profile shown in Figure 2.3-1. Use of Arrhenius methodology for thermal aging is considered acceptable in Regulatory Guide 1.89, Rev. 1, *Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants*.

RAI # 2

With regards to Section 2.3.1, provide, in table form, a list of parameters (i.e., temperature, pressure, humidity, chemical spray, submergence, and radiation) that shows that the EQ limits remain bounding under EPU conditions for Normal Operation, Accident (LOCA), Accident (MSLB/HELB), and Post Accident for both inside and outside containment (e.g., Auxiliary Building, Turbine Building, Containment Façade, etc.). Include the existing EQ limits in your response and show how EQ margins (e.g., temperature, pressure, radiation, etc.) are being maintained.

Response

The changes to EQ parameters potentially changed due to EPU are summarized in Table 2-1; changes are discussed in more detail below.

Table 2-1

Environmental Parameter	Inside Containment	Outside Containment
Temperature, Normal	No Change	No Change
Temperature, Accident	No change in peak. Long term profile changes for LOCA inside the drywell	HELB - No change in peak; short term profile changes. LOCA – Increase in peak and change in profile in some areas
Pressure	No Change	No Change
Humidity	No Change	No Change
Chemical Spray	No Change	No Change
Submergence	No Change	No Change
Radiation	Total integrated dose (TID) increases in all areas	TID increases in many areas

No changes to maximum room temperatures are required due to EPU during normal operation. EPU does not change relative humidity, peak pressures, chemical spray, or flooding effects due to a LOCA or MSLB/HELB.

Temperature Inside Containment

As shown in EPU LAR Attachment 5, Figure 2.3-1, the containment temperature profile for EPU only exceeded the CLTP envelope in the period beyond 60 days in the drywell, which is addressed in RAI #1. EPU did not change any peak temperatures used for qualification of EQ equipment inside containment; therefore, CLTP margins for this equipment remain unchanged for EPU.

Temperature Outside Containment

Table 2-2 reflects the EPU temperature impact to EQ equipment due to LOCA considering the lowest qualification test temperature for any qualified component located in the affected areas and the most limiting (highest) calculated EPU temperature for those areas.

Table 2-2
LOCA Outside Containment

Lowest Test Temperature (°F)	Peak EPU Temperature (°F)
212	163

CLTP EQ temperature margins for the peak MSLB / HELB temperatures were not affected by EPU. However, the EPU temperature profile for MSLB / HELB will change. EPU LAR Attachment 5, Figure 2.3-1 shows that the EPU MSLB / HELB temperature profile changes during the first 200 seconds of the event, with the short term plateau rising to 304°F for approximately 200 seconds. For any qualified equipment located in the affected areas that is required to function during this event, the lowest qualification test temperature for aging (with a duration greater than 200 seconds) is 318°F.

<u>Radiation Environment Inside and Outside Containment</u>

Table 2-3 identifies each type of equipment qualified in the GGNS EQ program along with the qualification TID and the EPU TID for the most limiting environmental zones (inside and outside containment) in which the equipment is qualified to be located. The listed EPU TID includes normal dose plus 1.1 times the accident dose; therefore, it includes the 10% margin on the accident dose required per IEEE 323-1974. Additional margin (beyond IEEE 323-1974 requirements) is also shown reflecting the difference between the equipment's qualified TID and the EPU TID.

<u>EQ Equipment Identified As Requiring Replacement</u>

Several items were identified in the EPU LAR Attachment 5, Table 2.3-2 as requiring replacement. Some of these items have been re-evaluated based on location specific doses and found to be acceptable for EPU without modification. All of the items on Table 2.3-2 have been qualified for EPU with the exception of the Electro Products Scotch Tape Electrical Splices associated with the RHR Jockey Pump motors (1E12C003A and B) and four of the Residual Heat Removal (RHR) motor operated valves (MOVs) listed on the table (1E12F003A, 1E12F024A, 1E12F024B, and 1E12F048A). As indicated in Entergy's letter dated November 12, 2010 (GNRO-2010/00071, NRC ADAMS Accession Number ML103260003), these splices are to be replaced with qualified splices.

Table 2-3

Equipment Affected By EPU Revised Radiation Total Integrated Doses				
Environmentally Qualified Equipment	**IC/OC***	**Qualification TID (rads)**	**EPU TID (rads)**	**EPU TID % Margin****
ASCO HTX Series Solenoid Valves	IC	2.00E+07	1.05E+07	47.8
ASCO NP Series Solenoid valves	IC	2.00E+07	2.00E+07	0.2
AVCO Solenoid Valve Cluster Assembly for Main Steam Isolation Valve (MSIV) Actuators	IC	5.00E+07	4.99E+07	0.2
Conax Electrical Conductor Seal Assemblies (ECSAs)	IC	2.25E+08	8.55E+07	62.0
Crouse Hinds Drywell Seal Condulets	IC	1.02E+08	4.99E+07	51.1
Eugen Seitz Main Steam Safety Relief Valve (MSSRV) Control Valve Assemblies	IC	2.92E+07	2.92E+07	0.0
FCI Water Level Sensors	IC	1.15E+08	1.05E+07	90.9
GE Vulkene SIS wire	IC	2.00E+08	1.62E+08	18.8
Limitorque with AC class RH Motors	IC	2.00E+08	1.98E+08	0.9
Morrison-Knudsen Hydrogen Igniters	IC	1.23E+09	4.99E+07	95.9
MSSRV Control Valve Assemblies with Ethylene Propylene Diene Monomer (EPDM) Elastomers	IC	2.44E+08	4.99E+07	79.6
Patel Connectors and Conduit Seals (EGS)	IC	2.00E+08	7.49E+07	62.6
PCI Pressure Switches	IC	5.00E+07	6.27E+06	87.5
Pyco Temperature Elements	IC	2.20E+08	7.12E+07	67.6
Raychem Cable and Instrument Sealing Products	IC	1.96E+08	1.96E+08	0.1
Reliance Drywell Purge Compressor Motors	IC	1.10E+08	5.72E+06	94.8
Rockbestos SIS Wire	IC	2.00E+08	7.49E+07	62.6
Rosemount 1152 Transmitters	IC	5.00E+06	8.95E+05	82.1
Rosemount 1152T0280 Transmitters	IC	2.20E+07	6.17E+06	72.0
Rosemount 1153 with R-output code	IC	2.44E+07	6.16E+06	74.7
Rosemount 1153B Transmitters	IC	2.44E+07	6.27E+06	74.3
Rosemount 1153D Series Transmitters	IC	5.19E+07	6.16E+06	88.1
ThermoElectric Temperature Elements	IC	5.00E+07	4.99E+07	0.2
Thermon Heat Tracing	IC	9.20E+06	6.17E+06	33.0
Victoreen Hi Rad Radiation Detectors and Cables	IC	2.20E+08	7.49E+07	66.0
AMP Terminals and Splices	IC/OC	2.60E+08	7.18E+07	72.4
BIW SIS Wire	IC/OC	4.00E+08	3.52E+08	11.9
Buchanon Terminal Blocks	IC/OC	1.00E+09	2.16E+08	78.4
Cinch-Jones Terminal Blocks	IC/OC	1.00E+09	2.69E+08	73.1
Curtis Terminal Blocks	IC/OC	1.00E+09	2.69E+08	73.1

Table 2-3

Equipment Affected By EPU Revised Radiation Total Integrated Doses				
Environmentally Qualified Equipment	**IC/OC***	**Qualification TID (rads)**	**EPU TID (rads)**	**EPU TID % Margin****
EGS Grayboot Connectors	IC/OC	2.00E+08	8.55E+07	57.3
EGS Quick Disconnects	IC/OC	2.50E+08	8.55E+07	65.8
GE Terminal Blocks	IC/OC	1.00E+09	2.69E+08	73.1
General Purpose Lubrication	IC/OC	2.28E+08	2.28E+08	0.0
Kulka Terminal Blocks	IC/OC	1.00E+09	2.69E+08	73.1
Limitorque Actuators with Fiberite	IC/OC	2.28E+08	2.16E+08	5.2
Marathon Terminal blocks	IC/OC	1.00E+09	2.69E+08	73.1
Okonite Power and Control Cable	IC/OC	2.00E+08	1.23E+08	38.5
Raychem Coax, Triax, Twinax, and Specialty Cable	IC/OC	2.00E+08	1.23E+08	38.5
Rockbestos Coax and Twinax Cable	IC/OC	2.00E+08	1.23E+08	38.5
Rockbestos Firewall III Power and Control Cable	IC/OC	2.00E+08	1.23E+08	38.5
Rockbestos Firewall III Specialty Cable	IC/OC	2.00E+08	Note 1	Note 1
Rockbestos I&C Cable	IC/OC	2.00E+08	1.23E+08	38.5
Samuel Moore I&C Cables	IC/OC	2.00E+08	1.23E+08	38.5
Samuel Moore Thermocouple Extension Wire	IC/OC	2.00E+08	1.23E+08	38.5
Teledyne Thermatics SIS Wire	IC/OC	2.08E+08	1.77E+08	15.0
ABB Brown-Boveri 480V Load Centers	OC	1.70E+05	1.64E+05	3.4
Anaconda SIS Wire	OC	2.00E+08	1.88E+07	90.6
Comsip Delphi Hydrogen Analyzer Panels	OC	1.20E+05	9.74E+04	18.8
GE ECCS Pump Motors	OC	6.00E+07	4.56E+07	24.1
Gould 125 VDC Starters	OC	1.00E+06	5.26E+04	94.7
Gould Electrical Penetration Protection Cabinets and Motor Short Circuit Protectors (MSCPs)	OC	1.00E+07	3.50E+05	96.5
Gould Handswitch Stations	OC	8.60E+05	1.94E+05	77.5
Gould Transmitters	OC	3.66E+07	5.43E+05	98.5
ITT Electric Control Actuators	OC	1.00E+07	1.00E+07	0.0
Kerite 9Kv Power Cable	OC	2.00E+08	8.55E+07	57.3
K-M 480V Motor Control Centers	OC	1.00E+05	4.52E+04	54.9
Limitorque with DC Class H and RH Motors	OC	1.00E+07	9.49E+06	5.1
Limitorque with AC Class H and B and DC Class B Motors	OC	2.00E+07	6.07E+06	69.6
Local Control Station 1H22P295	OC	1.30E+06	6.15E+04	95.3
Namco EA180 Limit Switches	OC	2.04E+08	6.42E+07	68.5
Namco EA740 Limit Switches	OC	6.90E+07	6.60E+07	4.3

Table 2-3

Equipment Affected By EPU Revised Radiation Total Integrated Doses				
Environmentally Qualified Equipment	**IC/OC***	**Qualification TID (rads)**	**EPU TID (rads)**	**EPU TID % Margin****
Raymond Control System Damper Actuators	OC	1.00E+07	7.38E+06	26.2
Reliance Fan Motors	OC	2.00E+08	1.64E+07	91.8
RTE Delta 125 VDC Distribution Panels	OC	3.05E+05	8.23E+04	73.0
Scotch Tape Splices	OC	2.05E+07	1.88E+07***	8.5***
Siemens MSIV LCS Blowers	OC	4.60E+07	5.73E+06	87.5
Standby Gas Treatment System (SGTS) Heaters and Controls	OC	1.13E+08	1.13E+08	0.0
Target Rock Solenoid Valves	OC	1.00E+08	6.38E+07	36.2
Westinghouse Jockey Pump Motors	OC	1.13E+08	4.75E+07	57.9
Westinghouse Electrical Penetrations	OC	2.20E+08	4.99E+07	77.3
Westinghouse SGTS Exhaust Fan Motors	OC	1.13E+08	1.13E+08	0.0

* IC – Inside Containment, OC – Outside Containment

** The EPU TID % Margin reported is available margin above the 10% required by IEEE 323-1974.

*** The EPU TID and EPU % Margin are for the components with the highest acceptable TID for the splices. This does not include those splices that are to be replaced.

Note 1: This cable is qualified using required insulation thickness for the TID it receives. The required insulation thickness is 19.19 mils; the cable has 21 mils of insulation which is a 20% margin in insulation thickness.

RAI # 3

In Section 2.3.2.1 of the LAR, the licensee stated that the grid stability analysis has determined that the power uprate will not adversely affect bulk power transmission system steady-state power flow (thermal ratings and voltage), stability, short circuit duty, or power transfer level. Provide a detailed discussion on the effects of the power uprate on the degraded voltage setpoint and how the existing setpoint remains acceptable under EPU conditions.

Response

The grid stability analysis evaluated the impact of the EPU on the off-site power transmission system (i.e., the grid). The evaluation of the impact of EPU on the on-site power distribution system, including the degraded voltage protection system, was performed separately and is described below.

As described in UFSAR section 8.3.1.1.2.2, degraded voltage protection for safety related buses is provided by:

"three sets of bistable devices which monitor voltage at the ESF bus of its safety division. Each set of bistables is arranged in a one-out-of-two twice logic. A measured nominal voltage of less than 70 percent for 0.5 second indicates unacceptable degradation (total loss) of the preferred source that is connected to the bus."

"The second set is arranged to act upon observing a nominal bus voltage between 70 percent and 90 percent for 9 seconds when the bus is connected to an offsite (preferred) source."

Calculations were performed using Electrical Transient Analyzer Program (ETAP) version 7.0.0N (refer to RAI #7 for more details), to evaluate the performance of the GGNS auxiliary electric power distribution system under EPU conditions, with respect to satisfying the degraded grid voltage and voltage recovery set point requirements. More specifically, steady state load flow, static and dynamic motor start and short circuit calculations were performed to:

- Determine and assess the acceptability of bus and equipment steady state voltages under maximum load and minimum source voltage and minimum load and maximum source voltage conditions.
- Determine motor start voltage at the instant of motor start, using static motor start simulations, under maximum load and minimum source voltage condition and evaluate the acceptability of motor voltage with required acceptance criteria.
- Determine motor and bus voltage and voltage recovery time, using dynamic motor start simulations, and evaluate the acceptability of results by comparing them with voltage and bus voltage recovery time acceptance criteria.
- Determine maximum available short circuit current duties for the medium and low voltage buses.

The results of the calculations, relative to degraded voltage relays are summarized in Table 3-1:

Table 3-1

4160 V ESF Bus	15AA	16AB
Drop Out Voltage (V)	3831.5	3831.5
Drop Out Voltage (% of rated)	92.1	92.1
Reset Voltage (V)	3859.1	3859.1
Reset Voltage (% of rated)	92.8	92.8
Minimum Allowable Time Delay to Reset (sec)	8.5	8.5
Maximum EPU Time to Reset (sec)	1.6	1.5
Maximum Voltage Drop Below DO Setting (V)	137.0	84.9

These results indicate:

- No change is required to the degraded voltage setpoints as a result of EPU.
- Analysis of the results of the LOCA sequencing study shows that the undervoltage relay on each of the ESF buses is able to reset within the relay minimum time delay setting of 8.5 seconds following a dropout, with a maximum recovery time less than 1.7 seconds.
- Reliable voltage above the undervoltage relay reset value is available at the 4160V safety-related ESF buses 15AA and 16AB since the voltage dips during motor start transients recover quickly relative to sequencing other loads onto the buses.
- The lower 70% setpoint is not approached due to station load transients.

RAI # 4

In Section 2.3.2.2 of the LAR the licensee stated that the existing protective relay settings for the main generator will have to be recalculated due to the increased EPU power output. Further, in Attachment 8 to the EPU, the licensee stated that changes to the protective relay setpoints for the main unit differential and main transformer differential relays are required due to EPU power output levels and the increased size of the main transformer. Provide further discussion in regards to calculations performed to demonstrate the adequacy of the new relay settings for the main generator and main transformers.

Response

The setpoints for the Main Generator and Main Transformer protection relays that were potentially affected due to the EPU power and current levels were examined. These were the Main Generator Differential, Negative Phase Sequence, Phase Distance, Power Directional, and Loss of Field, as well as the Main Transformer Differential and the Unit Differential. The inputs that changed by EPU were the Current Transformer (CT) ratios on the low voltage (22kV) side and the maximum generator current, calculated at 1600 MVA. The revised calculations demonstrate that the setpoints for these relays are adequate for EPU conditions and will not be changed.

Other protective relays associated with the Main Generator, namely Generator Undervoltage, Neutral Time Overcurrent, Volts/Hertz, Low Frequency Ground Fault, Under-frequency and Synch Check, were not affected by EPU.

Based on the further evaluation described above, it was concluded that no changes are required to the protective relay setpoints for the Main Unit Differential and Main Transformer Differential relays. Therefore, the changes reflected in EPU LAR Attachment 5, Section 2.3.2.2 and Attachment 8, List of Planned Modifications, are no longer needed.

RAI # 5

In Section 2.3.3.2, the license stated that selective coordination is maintained between the pump motor breakers and the 34.5 kilovolt (kV), 6.9 kV, and 4.16 kV switchgear main feeder breakers. Explain what is intended by 'selective coordination.'

Response

Use of the adjective "selective" in the subject sentence was extraneous in this case. The sentence should have read, "Coordination is maintained between the pump motor breakers and the 34.5 kV, 6.9 kV, and 4.16 kV switchgear main feeder breakers." None of the EPU changes to AC On-Site Power (Normal Operation) will have an impact on the existing coordination of protective devices.

RAI # 6

In Section 2.3.3 of the LAR, the licensee stated that there are no changes to the emergency diesel generator loads or load sequencing for EPU. Describe the impact on the emergency diesel generators due to the extended loading time resulting from the EPU?

Response

There are no changes to the emergency diesel generator loads, load sequencing, or equipment loading times due to EPU. Therefore, the existing emergency diesel generator loads, load sequencing and equipment loading times remain bounding at EPU conditions.

RAI # 7

In Section 2.3.3 of the LAR, the licensee stated that the electrical analysis software Electrical Transient Analysis Program (ETAP) was utilized to compute load, voltage drop, and short circuit current values for the alternating current power components. Describe the pedigree of the ETAP software (i.e., is it a nuclear qualified version) used to perform these electrical analyses. Provide a summary of the results obtained from ETAP that shows the changes in electrical load demand.

Response

The Load Flow, ANSI Short Circuit, and Motor Start analysis modules of the ETAP 7.0.0N (nuclear version) software were used for the EPU analysis. The ETAP software is licensed for use by Operation Technology, Inc. (OTI). The nuclear version of ETAP is verified and validated by OTI and is version controlled with each licensee; notifications are issued to each licensee when changes are available to correct or enhance certain features. Specific test problems are also provided to each licensee to allow benchmarking of each installation of the software to ensure correct and consistent results are calculated. The specific application of ETAP 7.0.0N used for this EPU evaluation was qualified for use in accordance with Shaw's QA Program for software usage, which complies with NQA-1 (*Quality Assurance Requirements for Nuclear Facility Applications*), Subpart 2.7, Editions 1994 through 2004.

To evaluate the impact on plant hardware, the CLTP ETAP plant model was modified to incorporate the plant electrical loading changes due to EPU; the changes in electrical loading are provided in the EPU LAR Attachment 5, Table 2.3-4.

Tables 7-1 and 7-2 provide a summary of the effect of these load changes on the plant electrical load demand. The comparisons shown in these tables demonstrate the adequacy of the electrical systems for the EPU changes.

Table 7-1
Transformer Loading Evaluation

XFMR #	Rating	Maximum CLTP Load (MVA)	CLTP % Margin	Maximum EPU Load (MVA)	Increase (MVA)	EPU % Margin
Service XFMR #11	500/34.4kV, 90MVA	40.54	54.96	42.639	2.099	52.62
Service XFMR #21	500/34.4kV, 90MVA	43.537	51.63	44.141	0.604	50.95
BOP XFMR #14	34.4kV/13.8kV, 12MVA	3.742	68.82	5.275	1.533	56.04
BOP XFMR #13	34.4kV/4160V, 7.5MVA	2.336	68.85	2.881	0.545	61.59
BOP XFMR #23	34.4kV/4160V, 7.5MVA	2.487	66.84	3.033	0.546	59.56
ACT XFMR #1X191 (1R20S910)	13.8kV/480V, 3.75MVA	1.836	51.04	2.566	0.73	31.84
ACT XFMR #1X192 (1R20S920)	13.8kV/480V, 3.75MVA	1.824	51.36	2.554	0.73	32.16
XFMRLC – 11BD2	6.9kV/480V, 0.75MVA	0.7119	5.08	0.7179	0.006	4.28
XFMRLC – 12BE4	6.9kV/480V, 0.75MVA	0.649	13.47	0.699	0.05	6.80
XFMRLC - 13BD1	4160V /480V, 0.75MVA	0.696	7.20	0.721	0.025	3.87
XFMRLC – 13BD2	4160V/480V, 0.75MVA	0.6507	13.24	0.7007	0.05	6.57
XFMRLC - 14BE1	4160V/480V, 0.75MVA	0.735	2.00	0.742	0.007	1.07

Table 7-2
Steady-State Continuous Current

Bus ID #	Designed Bus Rating (Amps)	Maximum CLTP Load (Amps)	Maximum EPU Load (Amps)	Increase (Amps)	% Margin	Comments
34.5kV Bus						
11R	3000	692.8	730.7	37.90	63.47	Note 1
21R	3000	723.7	734.5	10.80	63.28	Note 1
12R	2000	624.3	652.5	28.20	67.38	
13R	2000	528.5	529.8	1.30	73.51	
13.8kV Switchgear Bus						
19UD	1200	164.7	233.7	69.00	80.53	
6.9kV Switchgear Bus						
11HD	2000	1654.2	1656.2	2.0	17.19	
12HE	2000	1641.7	1647.0	5.30	17.65	
4160V Switchgear Bus						
18AG	1200	334.5	415.1	80.60	65.41	
28AG	1200	355.4	435.7	80.30	63.69	
13AD	2000	1907.6	1913.7	6.10	4.32	
14AE	2000	1663.2	1664.7	1.50	16.77	
15AA	2000	239.2	239.1	-0.10	88.05	Note 2
16AB	2000	534.4	534.4	0.00	73.28	
17AC	2000	40.1	40.1	0.00	97.99	
480V Load Center Switchgear Bus						
19BD1	5000	2375.6	3367.3	991.70	32.65	
19BD2	5000	2360.4	3351.4	991.00	32.97	
11BD2	1600	1379.0	1388.6	9.6	13.21	
12BE4	1600	863.0	936.00	73.00	41.50	
13BD1	1600	915.0	947.2	32.2	40.8	
13BD2	1600	1422.5	1422.0	-0.5	11.13	
14BE1	1600	898.5	907.3	8.8	43.29	
480V MCC Switchgear Bus						
19B13	2000	0	949.6	949.60	52.52	
19B23	2000	0	949.3	949.30	52.54	
11B21	600	452.4	462.5	10.1	22.92	
13B11	600	213.8	250.1	36.30	58.32	
14B12	600	326.0	336.2	10.20	43.97	

Notes:

1 The 11R and 21R buses are rated for 3000 amps each; however, ETAP models and margins for 11R and 21R are based on the feeder breaker rating which is 2000 amps.

2 Apparent decrease in amps is due to rounding not an actual load decrease.

RAI # 8

In Section 2.3.5 of the LAR, the licensee stated that evaluation of the Class 1E battery capacity has shown that there is enough battery capacity to support decay heat removal during SBO for the required coping duration. Provide detailed information that shows that the Class 1E battery capacity and Compressed Air Capacity remain bounding for Station Blackout under EPU conditions (i.e., provide the pre and post-EPU capacities and the design capacity of the Batteries and Compressed Air supply).

Response

Class 1E Battery Capacity

The Division I & II, Class 1E batteries were designed, built, and rated to perform in accordance with recognized industry codes and standards. Each Class 1E battery is capable of supplying the required load cycle for 4 hours and to perform three complete cycles of intermittent loads of 1 minute duration, occurring at 0, 120 and 239 minutes, after the loss of AC power without the voltage at the battery terminal falling below 105 volts. The battery sizing also includes a minimum operating temperature correction factor and a 125 percent aging factor to permit operation of the battery down to 80 percent capacity. The battery sizing also considers that one cell is out for replacement or maintenance.

The Division I & II Class 1E battery parameters are as follows:

Type of battery	Lead Calcium
Number Cells	61
Capacity	2,320 Ampere-Hours at 8 hour rate
Volts/Cell (minimum)	1.75 (at design discharge condition)
Volts/Cell (maximum)	2.295 (during equalizing charge)
DC System voltage range	105 to 140 volts

Table 8-1 summarizes the calculated Class 1E battery size requirements and calculated CLTP and EPU loads. The calculations demonstrate that there is ample battery capacity in the Division I and II DC system for the 4 hour SBO event. Since EPU does not add load to the Division I or II 125 VDC system, the Class 1E battery capacity remains bounding for Station Blackout under EPU conditions.

Table 8-1

Division	Required Capacity for 4 Hour Discharge (Plates/Cell)		Minimum Voltage Maintained After 4 Hour Discharge (VDC)		Calculated Battery Ampere-Hours After 4 Hour Discharge (A-H)	
	Required	**Provided**	**CLTP**	**EPU**	**CLTP**	**EPU**
I	21	33	>105	>105	706.68	706.68
II	19	33	>105	>105	677.0	677.0

<u>Compressed Air Capacity</u>

An assessment for compressed air capacity is performed to ensure that air operated valves required for decay heat removal have sufficient reserve air or can be manually operated under station blackout conditions for the specified duration.

GGNS compressed air capacity meets the requirement to support the SBO response. GGNS air operated valves that are required for decay heat removal have sufficient compressed air for the required automatic and manual SRV operations during the SBO event for EPU conditions. Furthermore, sufficient capacity remains to perform emergency RPV depressurization (Automatic Depressurization System initiation) in case it is required. The required SRV cycles (demand) for SBO at EPU conditions is obtained from the analysis. The comparison of demand for EPU relative to CLTP is summarized in Table 8-2.

Table 8-2

Parameter	Units	CLTP Value	EPU Value	EPU - CLTP Change	Design Limit / Acceptance Criteria	Comment
SRV Manual Pressure Reduction Cycles	No. of cycles	61	86	25	<200	The number of cycles for both cases is less than the compressed air capacity acceptance criteria (<200 cycles). Additional cycles were experienced for the EPU case due to cooldown rate adjustment toward the end of the coping period.

RAI # 9

In Section 2.3.5 of the LAR, the licensee stated that evaluation of areas with equipment necessary to cope with station blackout (SBO) has shown that equipment operability is maintained because the SBO environment is milder that the existing design and qualification bases. Provide the summary of this evaluation.

Response

The plant areas that house equipment required to function during a SBO event were conservatively evaluated to assess the area temperature increase during a SBO event. A summary of the evaluation performed for each area is provided below.

1. Control Room and Upper Cable Spreading Room

   A CLTP evaluation of the control room, including the control cabinet area above the control room, and upper cable spreading room heat load following a loss of ventilation demonstrated that the maximum air temperature would reach approximately 94°F. These rooms are classified as Condition 1 rooms in accordance with NUMARC 87-00, *Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors* (Revision 1, August 1991). Condition 1 areas are those that do not exceed a maximum temperature of 120°F. NUMARC 87-00, Section 2.7.1, further states: "By opening cabinet doors, adequate air mixing is achieved to maintain internal cabinet temperatures in equilibrium with the control room temperature. Therefore, cabinets containing instrumentation and controls required for achieving and maintaining safe shutdown in a station blackout are considered to be in Condition 1. As such, additional cooling may be provided in a station blackout by opening cabinet doors within 30 minutes of the event's onset." GGNS station procedures provide administrative guidance requiring operators to take such precautionary actions for enhanced cooling of this equipment.

   Equipment in the upper cable spreading room is not impacted by EPU. The maximum air temperature in that room due to the heat load following a loss of ventilation remains unchanged at EPU.

   As a result of a modification being implemented at EPU, new Power Range Neutron Monitoring (PRNM) equipment is being added to both the control room and the control cabinet area above the control room. A conservative evaluation of the heat load in each of these areas following a loss of ventilation demonstrates that the maximum expected control room temperature would increase by less than 1°F and the maximum expected control cabinet area temperature would increase by less than 1.5°F. Thus, the maximum steady state air temperature in these areas remains significantly less than the NUMARC 87-00 recommended maximum of 120°F.

2. Reactor Core Isolation Cooling (RCIC) Pump Room

   The current evaluation of the RCIC pump room following a loss of ventilation indicated that the maximum air temperature would reach 123°F at six hours. The suppression pool temperature will not impact the RCIC room since the main source of water supply during SBO is the Condensate Storage Tank. Since no changes were made to the RCIC pump room equipment due to EPU, there is no additional heat load generated. The room temperature remains unchanged at EPU conditions.

3. Steam Tunnel

   The main steam tunnel area outside containment had been eliminated as a dominant area of concern for the SBO event for the CLTP conditions. A station off-normal event procedure provides instructions for bypassing the RCIC steam tunnel high temperature trip feature to ensure RCIC availability during the SBO coping period. The effect of heat buildup due to RCIC steam line operation will not impact area equipment since no credit is taken for long term operation of other systems in this area (besides RCIC) during this period. Furthermore, EPU does not impact this area since the process parameters for RCIC operation remain unchanged at EPU conditions.

4. Switchgear Room / Inverter Room

   The heat loads used in the design basis evaluation of the switchgear/inverter rooms under SBO conditions remain unchanged at EPU conditions. Thus, EPU will have no adverse impact on the temperature of the switchgear/inverter rooms under SBO conditions.

5. Drywell

   The current design basis analyses of the drywell and suppression pool areas under SBO conditions indicate sufficient margin exists between peak temperatures and design temperatures for CLTP conditions. An evaluation of these areas under SBO conditions at EPU demonstrates that the peak temperature remains below the design temperature. Any increases in heat load from these areas to adjacent rooms evaluated under SBO conditions are limited and not significant during the four hour coping period. The effect of increased seal leakage from the recirculation pumps was evaluated for the drywell area and the evaluation demonstrated that the design temperature remains bounding during SBO. Therefore, at EPU conditions the drywell and suppression pool area temperatures remain within the design temperature.

RAI # 10

Appendix H of NUMARC 87-00 Rev. 1 lists the dominant areas of concern for the analysis of the effects of loss of ventilation under SBO conditions. For boiling water reactors, the dominant areas of concern are the high-pressure coolant injection (HPCI)/high-pressure core spray (HPCS) and reactor core isolation cooling (RCIC) pump rooms and the main steam tunnel. In Section 2.3.5 of the LAR, the licensee stated that the following areas were evaluated for the effect of loss of ventilation due to an SBO: drywell, steam tunnel, RCIC room, control room and upper cable spreading room and switchgear room/inverter room. Please confirm that the HPCI/HPCS pump rooms have been evaluated for the effect of loss of ventilation due to an SBO and provide a summary of the evaluation

Response

The HPCS pump room was not evaluated for the effect of a loss of ventilation due to EPU. The GGNS plant specific SBO evaluation does not credit HPCS as a coping system and HPCS was not used in the SBO analysis. Thus, the HPCS room is not a dominant area of concern for the SBO response analysis.

RAI # 11

In Attachment 8 to the LAR, the licensee stated that the increased isophase bus current due to EPU will result in exceeding the design limit for both the main bus and the self-cooled delta bus. Further, the licensee proposes to replace the isophase bus duct cooler and fans to increase the heat removal capability of the bus duct cooling system for both buses. Provide further discussion in regards to calculations performed to demonstrate the adequacy of the new bus duct cooling system and how this system will be able to perform its function under EPU conditions.

Response

An evaluation of the existing isophase bus (IPB) duct was performed by an IPB duct manufacturer, which determined that the following modifications are required to operate the IPB at the EPU power level:

- Upgrade the delta buses from self-cooled to forced-cooled.
- Install a new IPB cooler with higher cooling capacity to remove the higher EPU heat loads.
- Change the existing IPB cooling air flow path to provide sufficient cooling air flow to remove the higher EPU heat loads and prevent hot spots.

- Increase the cooling water flow to the IPB cooler to dissipate the additional heat rejected by the IPB main bus, plus the heat rejected from the delta bus converted to forced-cooling.
- Increase cooling fan air flow and motor horsepower to provide sufficient cooling.

The IPB manufacturer modeled the IPB enclosure, bus conductors and IPB cooling system, and prepared performance calculations at CLTP and EPU full load IPB current. The calculations considered the temperature rise through the bus from increased current, along with material and environmental effects. The software model used for the EPU evaluation of the IPB was benchmarked against the existing IPB performance. A computational fluid dynamic analysis was performed to pinpoint potential hot spots in the IPB and optimize air flow at EPU conditions. The IPB manufacturer’s evaluation demonstrates that the IPB will be able to perform its intended function at EPU conditions with either the three (3) single phase Main Transformers in operation, or with the spare Main Transformer operating in place of one of the three (3) single phase Main Transformers following implementation of the bulleted modifications listed above.

RAI # 12

In attachment 12 to the LAR, “Grid Stability Evaluation,” the gross generation at maximum power is stated to be 1503.5 Mega Watts electric (MWe), whereas Table 2.3-3 in Safety Analysis Report indicates the EPU duty as 1600 Mega Volt Amperes at 0.95 power factor which translates to 1520 MWe. Please explain the differences of these two values and provide the maximum output of the generator in MWe with power factor value on EPU duty.

Response

The value of 1503.5 MWe reported in Attachment 12 to the EPU LAR is based on a targeted 178 MWe EPU increase above the present nominal operating point. The value of 1600 MVA at 0.95 power factor (PF) represents an estimated duty for the generator based on the winter heat balance for the EPU configuration of 1523.5 MWe (1600 MVA at 0.952 PF). The maximum expected gross output is 1523.5 MWe at a PF of 0.952 under EPU conditions.

Note, Entergy has determined the statement in Attachment 12 about maximum gross generation ("To accommodate seasonal swings in MWe output, the grid stability analysis was evaluated assuming a maximum gross generation of 1503.5 MWe.") is incorrect. The grid stability analysis, performed for our Independent Coordinator of Transmission, conservatively considered a value of 1544 MWe.

RAI # 13

In attachment 12 to the LAR, "Grid Stability Evaluation," it is stated that approximately 216 Mega Volt Amperes Reactive of additional reactive power capability is required to meet the Interconnection Agreement. It is also stated that the capacitor banks will be installed throughout the system and will be controlled by operational procedure. Please confirm that these capacitors are scheduled to be installed and connected to the system prior to EPU operation.

Response

All scheduled capacitor banks are currently either in design or construction. There are no known constraints to the scheduled completion by 1/31/2011.